HGTD Testbeam in CERN

Suyu Xiao from IHEP 2018-11-09

2018 Program

		Neutron vs Proton Irradiation on Boron
April – May 2018:	\checkmark	Neutron vs Proton Irradiation on Boron
		implanted CNM 10478 wafers
June – July 2018:	- √	Proton irradiated Carbon diffused waters CNM
		10/79
	\checkmark	Un-irradiated Gallium implanted water spleted
	\checkmark	HPK
	_ ✓	AltiRoC v 0.1
September 2018:	 ✓ 	Neutron Irradiated Carbon diffused wafers
•		CNM10478 Comp
	\checkmark	Proton Irradiated Gallium Wafers
October 2018:	- √	Neutron Irradiated Gallium
	\checkmark	CNM AIDA – FBK
	\checkmark	AltiRoC v1.0

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1st **Article:** Proton vs Neutron Irradiation on Carbon diffused born wafers

2nd Article: Gallium effect on radiation hardness of LGAD sensors in Proton vs Neutron irradiation

Testbeam Equipment

Mechanics

SiPMs

MMC3

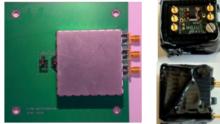
Mechanics, SiPM and FEi4

- 10 new board L-shape support brackets
- Easy installation and good alignment
- Simplified mounting
- Closer board distance
- 5 produced, 4 operational
- 3D printed quartz bar support problematic
 - Poor accuracy
 - Insufficient screw retention power
 - Need aluminum or steel mount
- Board performance poorer than expected
- Higher rise time (~1.2nsec) leading to 36psec resolution
- Higher capacitance due to connector pins?
- More stable than USB PiX
- No synchronization bug with telescope events
- Problematic with old FE-i4 A planes, compatibility questionable
- Only one available, belongs to MPI



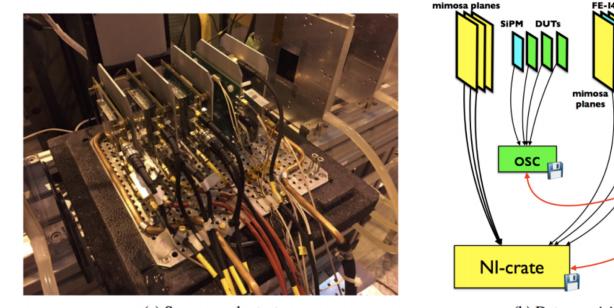
Board





Setup

- DUTs: LGADs sitting inside a cooling box
- SiPMs: for timing reference which sit in a separate cooling box (closed to light)



(a) Sensors under test

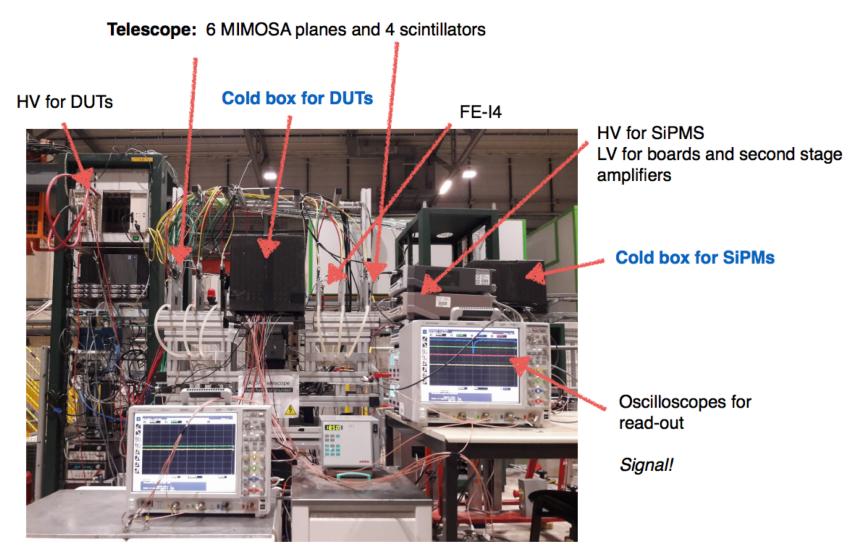
(b) Data acquisition setup

Scintillator

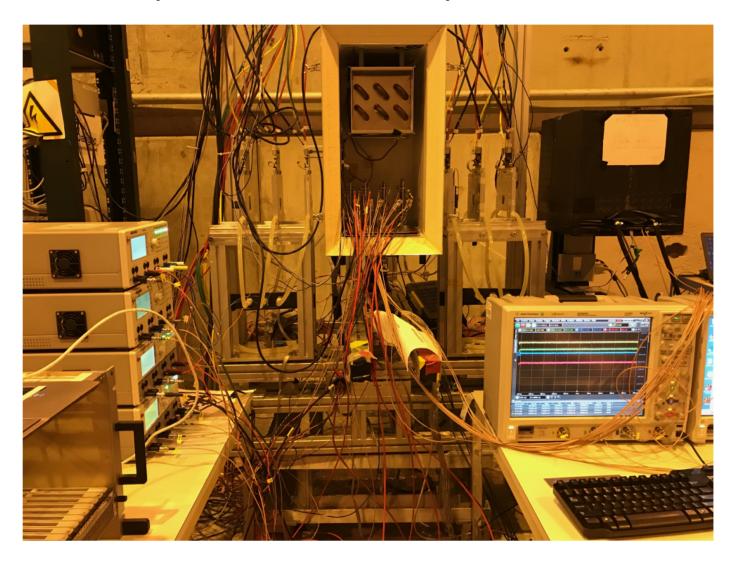
TLU

- Mimosa planes: Telescope used for tracking position / efficiency
- Fel4 + Scintillator: used for triggering
- Trigger Logic unit receives signal from FE-I4 and scintillator and sends signal to oscilloscope and NI-crate to save data (two separate files per run)

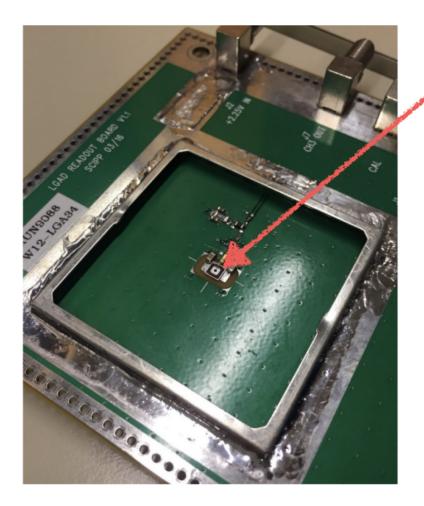
Basic Setup



Sensor setup with box open



Sensor and readout boards



- LGAD sensor taped to board
- Wire bonded to readout board
- Cables:
- HV in for Sensor O (100V)
- LV for board 2.25 V
- Calibration (not used in testbeam)
- CH3 out signal output
- An amplifier is put on the output of the signal —> goes to oscilloscope

- In case someone will take shifts in CERN or BESIII in future, I summarize something about taking shifts.
- Preparation
 - CERN account (done by email before arrival)
 - CERN card (building 55)
 - Dosimeter (building 55)
 - Access to The Area (through EDH)
 - Helmet, Protective shoes (paid by group)

Voltage Control

+	RDP 🔫	10)	4	
Name	Group	Server	Last time used	
🖻 Oscilloscope 2 (ric	ht)	192.168.4.71	2017-07-07 - 11:07:58	
한 DCS		192.168.4.5	2017-07-07 - 10:56:58	
Oscilloscope 1 (let	t)	192.168.4.70:5900	2017-07-07 - 10:55:57	
💠 NI crate		192.168.4.2	2017-07-07 - 10:55:31	
💠 Chiller control		192.168.4.33	2017-07-06 - 19:21:38	
한 Stage control		192.168.4.34	2017-07-06 - 16:35:59	
한 Agilent		192.168.4.245	2017-05-16 - 23:47:34	
한 USBpix		192.168.4.7	2016-10-26 - 08:29:43	
🔶 USBpix_2		192.168.4.14	2016-10-26 - 08:28:35	

CS 🗱 🚸 NI crate 🗱 🚸 Chiller control 🕱 🚸 Stage control 🕷

- Set the voltage of the individual sensors from **DCS**
- Start DCS and check the logbook for which sensors are on which HV channel —> it is not obvious!
- Set compliance in the lset value
- Set voltage in Vset -> right click on status -> on

Vnominal (V)		Iset (µA)	Im	easure (µA)	Inominal (µA)	Status CV CC
-2,000.00	Т	5.00 L		-0.0020 µA	4,000.00	Off
-2,000.00	Т	5.00 L		-0.0013 µA	4,000.00	Channel 0 Menu
-2,000.00	Т	5.00 L		-0.0013 µA	4,000.00	Carthe In
-2,000.00	Т	5.00 L	-	-0.0017 µA	4,000.00	Set Voltage
-2,000.00	Т	5.00 L		-0.0016 µA	4,000.00	Set Current
-2,000.00	Т	5.00 L		-0.0017 µA	4,000.00	Set On
-2,000.00	Т	5.00 L	L	-0.0020 µA	4,000.00	Set Off
-2,000.00	Т	10.00 L	L	Aµ 0.0016-	4,000.00	Set Emergency Off Clear Emergency Off
						Set Current Trip Set External Inhibit Action.
						Clear Events
						Status / Control

'HV' for SiPMs

LV for boards and amplifiers

Total 9 items.

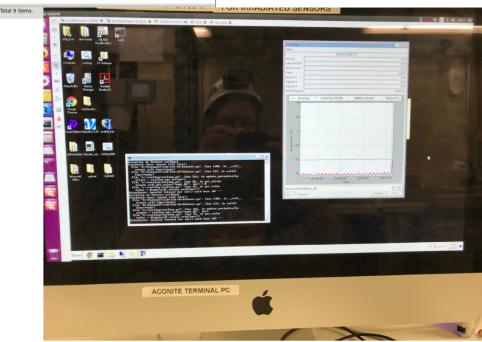
eithley 2400 Serie -0.3986 µA 4,000.0 2 000 00 0.6743 µA 4,000.0 -0.1133 μA 0.0016 µA 0.0020 uA 2 000.00 70.00 uA 50.00 UA 4.25 rmware Release -

HV for DUTs

• Temperature Control

+	RDP 🔫	E)	A	
Name	Group	Server	Last time used	
🛅 Oscilloscope 2 (right				
👳 DCS		192.168.4.5	2017-07-07 - 10:56:58	
🖲 Oscilloscope 1 (left)		192.168.4.70:5900	2017-07-07 - 10:55:57	
🕸 NI crate		192.168.4.2	2017-07-07 - 10:55:31	
한 Chiller control		192.168.4.33	2017-07-06 - 19:21:38	
😳 Stage control		192.168.4.34	2017-07-06 - 16:35:59	
한 Agilent		192.168.4.245	2017-05-16 - 23:47:34	
한 USBpix		192.168.4.7	2016-10-26 - 08:29:43	
한 USBpix_2		192.168.4.14	2016-10-26 - 08:28:35	

- Nominally we test sensors at -30 C
- Though could also test sensors at -20 C, so shifter may be asked to change the temperature of the chiller
- Also temperature needs to be ramped to + 20 C ahead of sensor replacements



- Click on Chiller control
- Set temperature at bottom under:

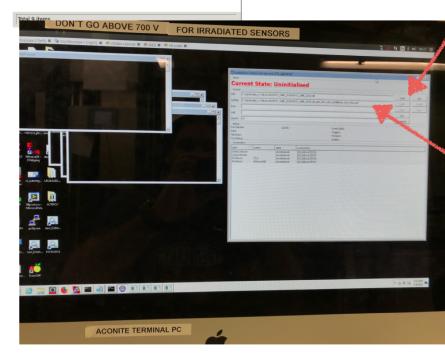
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- "Set end active Setpoint"
- Can see the temperature on the graph and in the top status

• Start and stop run

+	RDP 🔻	1	A	
Name	Group	Server	Last time used	
🖲 Oscilloscope 2 (rig				
💠 DCS		192.168.4.5	2017-07-07 - 10:56:58	
Cscilloscope 1 (let	ft)	192 168 4 70-5900	2017-07-07 - 10:55:57	
한 NI crate		192.168.4.2	2017-07-07 - 10:55:31	
한 Chiller control		192.168.4.33	2017-07-06 - 19:21:38	
💠 Stage control		192.168.4.34	2017-07-06 - 16:35:59	
한 Agilent		192.168.4.245	2017-05-16 - 23:47:34	
👲 USBpix		192.168.4.7	2016-10-26 - 08:29:43	
💠 USBpix_2		192.168.4.14	2016-10-26 - 08:28:35	



Go to NI crate and start EUDAQ by clicking on icon:
Start EUDET v17!! There is more than one EUDET icon!

• First check initialisation file should be (e.g.):

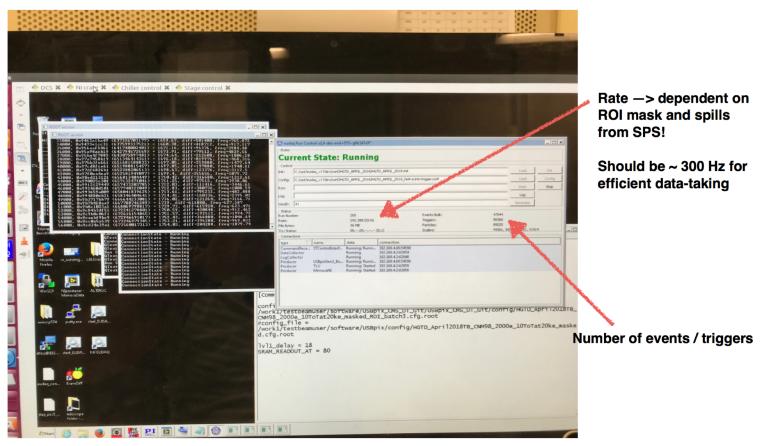
C:/opt/eudaq_v17dev/conf/HGTD_JUNE_2018/HGTD_JUNE_2018.init

- click initialise (only experts will modify this file)
- Load and choose the configuration from the window (*different for every batch*)

should have dei4_and_scintillator in the name

- Above is only done when re-starting EUDAQ
- If all above + DAQ + USBPix done, click start
 You are now running and taking data!
- Click stop when you want to stop run
 - Check number of events is -1 DAQ
 - Copy rate and number of events to log book

- Check Run Parameters
- Now you are running and taking data!
- Should monitor rate and number of triggers -> compare with DAQ numbers



- Check Data Quality
- Data quality checks are run via a terminal:
- python ~/HGTD/June18TB/Monitoring/dataMonitor.py [filename or path], where filename is the path to either the dat or the txt file and path is a directory (including subdirectories) to be monitored

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- Several pop-up windows
- One EXTREMELY useful is the signals from the oscilloscope channels
- Should be checked while datataking to spot any issues
- Should always see 2 SiPMS, reference LGAD and other signals accordingly

- Fill out the Log book
- It is required when a run is taken to fill out the information on the google spreadsheet
 - Can find the link on the specific testbeam twiki page -> should be always on in the hut!
 - Fill out comments!
- Check run numbers (both!), rate, sensor positions with voltages and leakage currents (also SiPM)
- DO NOT KILL HARTMUTS ets/d/1TY2CAEL-01KdH-6n9AEiMwMOOG1-SCyCfbKPloy2 (110%) ···· 🖾 🏠 Q Sear ♥ Vistars SPS1 ♥ Shuttle Circuit 2 ➤ Power Module ● File E SH 9 SETUP - RuninfoDBinputs - Run Log - Sensor IVs - General O

• Check these every single run!!

Thank you!